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## Cover Page Footnote

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# MATHEMATICS COREQUISITE REMEDIATION AND DIRECT ENROLLMENT: ADDRESSING MISCONCEPTIONS AND CONCERNS

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## ABSTRACT

In Fall 2020, the VCCS will begin implementing the Direct Enrollment Pilot, building upon lessons learned in prior reforms and successes of reforms in other states. In the new corequisite model of developmental education, students at the margins of college preparation are placed directly into the college coursework with a supplemental support class. This Notes in Brief article summarizes some of the research behind the transition towards this model and the implications of this scholarship on current reform efforts. It directly addresses concerns regarding the move towards corequisite instruction and provides recommendations for how to implement reforms.

## INTRODUCTION

Many students enter higher education with poor preparation for college mathematics courses. Historically, these incoming students have been required to take high-stakes placement tests that place many into developmental mathematics courses that do not bear credit towards graduation. At 2-year colleges, 59% of students enroll in developmental coursework (Chen, 2016), required as a prerequisite for college-level material. However, based on student pass rates and retention, developmental mathematics is more often a roadblock than a bridge to credit-level mathematics. Only 45% of students who enroll in developmental mathematics eventually earn

credit in college-level mathematics (Chen, 2016), a rate lower than that seen in developmental reading or writing (Bonham & Boylan, 2011).

Recent scholarship doubting the value of high-stakes placement tests and prerequisite developmental coursework has prompted major reform efforts across the nation. More students are now directly enrolling into gatekeeper college courses, such as Quantitative Reasoning, Statistical Reasoning, and Precalculus. To provide additional support, marginally prepared students will also be required to enroll into corequisite support classes that are paired with college-level courses, taught in the same semester. This document succinctly addresses a number of concerns and misconceptions surrounding the current reforms taking place in the Virginia Community College System (VCCS), with an emphasis on mathematics courses. Additionally, it provides an overview of recommendations from research and their consequences which can inform the Direct Enrollment pilot.

**Misconception:** Students cannot succeed in a college-level mathematics course without a foundation in basic algebra skills.

**Reality:** Research indicates that more students may be able to be successful in college-level mathematics coursework than the remedial algebra courses that typically serve as prerequisites for such courses. In a randomized control study by Logue, Watanbe-Rose, and Douglas (2016), students at marginal levels of preparation were randomly assigned to one of three courses: an elementary algebra course, an elementary algebra class with a workshop, or an elementary statistics course with corequisite support. While 56% passed the elementary statistics course, only 39% of students placed into an elementary algebra course were successful, which only improved to 45% of elementary algebra students with a workshop.

**Misconception**: Placing developmental-level students directly into credit-level coursework will have a disastrous effect on their grade outcomes in gatekeeper courses.

**Reality:** Several studies have suggested that the benefits of remedial coursework are minimal at best. Moss, Yeaton, and Lloyd (2014) looked at the effect of using two different placement score cutoffs using a randomized control trial. The lowest scoring students were sent to remediation, and the highest into credit-level coursework. Those scoring in the middle range were assigned to one or the other. Using causal quantitative methods, the authors estimated that the effect of receiving remediation increased performance in credit-level coursework. However, the improvement was minimal, slightly less than *one-third of a letter grade* – roughly the equivalent of moving from a C to a C+.

Quarles and Davis (2017) theorize that prerequisite developmental algebra courses have minimal benefit because they often emphasize procedural skills that are forgotten before the time a student can use them in a gatekeeper course. In their study, students starting a precalculus class after completing a mathematics course the previous semester correctly answered only about 52% of procedural skill-based questions on an assessment of prerequisite algebra material. Students who had not taken mathematics courses for at least a semester were only able to correctly answer 25 to 30% of these same procedural skill questions at the start of their precalculus course. So even when students do pass developmental coursework, they may have forgotten a majority of the skills they learn before they have an opportunity to use them in a college course.

**Concern:** The new placement measures will inaccurately identify students as ready for college-level mathematics.

**Reality:** High-stakes placement testing already inaccurately identifies students' preparedness for college-level mathematics. Upwards of one quarter of students assigned to developmental mathematics could have earned a B or better in gatekeeper courses, according to statistical analysis of factors predictive of success by Scott-Clayton, Crosta, and Belfield (2014) and Scott-Clayton and Rodriguez (2015). Research by Ngo and Kwon (2015) suggests that using high school GPA and previous mathematics coursework can identify additional students who can successfully complete college courses at rates similar to those identified by placement testing. Ultimately, all measures of placement will have flaws and limitations. Fortunately, well-implemented corequisite support courses (e.g., Adams et al., 2009) can address the limitations of placement measures by giving instructors opportunities to identify and address gaps in student knowledge.

**Concern:** Failure rates in gatekeeper courses will go up because of the increased number of underprepared students starting in college-level coursework.

**Reality:** It is a possibility that placing more students at the margins of preparation into higher-level coursework may negatively impact *overall* success rates in sections of gatekeeper courses. Faculty teaching these courses and administrators monitoring the impact of reforms should proactively address this scenario. However, it is a mistake to use this statistic as the sole measure of reform success.

Transitioning to corequisite models requires educators to reinterpret what counts as success. The most notable failure of prerequisite developmental sequences is that the majority of students who begin in developmental mathematics never successfully complete a college-level course (Chen, 2016). In fact, some studies suggest upwards of half of students do not even complete their *first* developmental course (Bailey, Jeong, & Cho, 2010). A more informative

metric to gauge the success of reforms is to see whether they increase the *number* of students passing gatekeeper courses.

Research on corequisite remediation is beginning to show substantial improvements in the ultimate success of underprepare students. The first causal quantitative research study on corequisite reforms started by Tennessee in 2015 have recently been compiled into a working paper by Ran & Lin (2019). Their research estimates that students placed into corequisite remediation are *15 percentage points* more likely to pass a gatekeeper level mathematics course within their first year than those placed into prerequisite developmental coursework.

**Misconception:** Research shows that developmental education is a programmatic failure and should be completely replaced by corequisite models of instruction.

**Reality:** Many studies that have measured the effectiveness of remediation have employed a quasi-experimental method called *regression discontinuity* (RD) design (e.g., Calcagno & Long, 2008; Martorell & McFarlin, 2012; Scott-Clayton & Rodriguez, 2015). This design investigates the impact of remediation by comparing students at either side of a cutoff score for a placement test. The first group is sent to remediation by scoring just under the threshold, while the second group is placed directly into gatekeeper courses; since the score difference between groups near the cutoff is small, statistical regression can provide a reasonable estimate of the causal effect of receiving remediation.

Results from these studies are mixed, but overall they support the conclusion that receiving remediation has a negligible impact upon success in future gatekeeper coursework or degree completion. In other words, these studies suggest that students at marginal levels of preparation are no more successful in future courses after receiving remediation; furthermore, beginning in developmental coursework does not improve retention. However, this conclusion must be

tempered by limitations of the RD design. Estimates for the impact of remediation are only valid for *individuals near the score cutoff* (Jacob et. al, 2012). That is, students *far below* placement thresholds may still benefit from prerequisite remedial coursework.

**Misconception:** The current reforms are the product of VCCS administrators who are unfamiliar with the classroom issues instructors face and just want to get rid of developmental education.

**Reality:** The VCCS Direct Enrollment Faculty Mathematics Leads subcommittee has been integral in crafting these reforms. The Steering Committee has approved a number of recommendations based on mathematics faculty suggestions for enhancing student success, including the following:

- Changing the goals of reform from *elimination* of prerequisite developmental education to *limiting* these courses to students with the greatest need for them
- Creating prerequisite developmental education courses – MDE 10, Introduction to Algebra, and MDE 60, Intermediate Algebra – that are focused on exactly the skills required in subsequent gatekeeper courses
- Increasing the number of credit hours of corequisite support classes (MDE 54, MDE 55, and MDE 61) to 3, allowing for additional contact time
- Collecting two years of data on student success (gatekeeper success rates, student retention) to inform decisions on scaling reforms across the system

**Misconception:** The new Mathematics Direct Enrollment (MDE) corequisite courses need to cover all of the content that used to be covered in the previous developmental sequences.

**Reality:** Misalignment between remedial and credit-level courses is one contributing factor to why students starting in prerequisite remediation struggle to succeed in credit-level coursework (Goldwasser, Martin, and Harris, 2017). The course objectives of the MDE courses overlap with those of their paired gatekeeper course. This reflects the goal to use the corequisite courses to provide whatever supports are necessary for success in the paired credit-level course. This may not entirely correspond with all of the previously covered objectives in MTE 1-9, particularly in MDE 54 & 5. Instructors in the new model could instead use instructional time, for example, to discuss calculators or spreadsheet software. Content that is no longer relevant for gatekeeper courses is no longer an objective.

**Misconception:** There is no point in gathering student feedback for the use of class time in MDE courses.

**Reality:** Students express varying preferences for use of class time (Beamer, 2019). Some students prefer to dedicate time in the class to work on homework, while others may prefer the instructor to review the most difficult concepts from the day's class. Given the need for the corequisite courses to respond to individual student needs, instructors may wish to take a balanced, structured approach. Instructors can use class time to clarify the week's concepts, offer additional individual or group practice, or encourage students to summarize and reflect on their learning. Research by Davis (2009) indicates that soliciting feedback throughout the semester can improve student motivation and learning outcomes.

**Misconception:** It does not matter how colleges implement corequisite instruction; it is only important that colleges abandon prerequisite developmental education.

**Reality:** There are multiple possible formats for implementing these corequisite classes. Some colleges in the Tennessee corequisite reforms offered face-to-face courses, while others administered them in a hybrid or online format (Ran & Lin, 2019). Research on the effectiveness of comparative models corequisite models of remediation are in their nascent stages. In their estimates of the causal impact of corequisite remediation, Ran and Lin (2019) note the limitation that they lacked details on the quality of implementation at institutions involved in reforms. Ongoing research on the impacts of design details on success outcomes is taking place in other states such as Texas (Daugherty et. al, 2018) Early research on corequisite pilot programs from Maryland (Adams et al., 2009) suggests several aspects that may help facilitate successful reform:

- Keep a *small class size* to increase the opportunities that corequisite instructors have to provide relevant remediation on a targeted basis.
- Use a *cohort of remediated students* from one section of a gatekeeper course so that students can build strong interpersonal relationships and feel comfortable asking questions.
- Schedule *heterogeneously grouped* sections of a gatekeeper course, mixing marginally prepared corequisite students with those who place directly may lead to positive peer effects on less-prepared students.
- Address both *credit-level and remedial-level content* in the corequisite course ensures that corequisite instructors can address whatever aspect is keeping their students from succeeding in the gatekeeper course.
- Attend to *non-academic issues* that interfere with student success, such as behavioral issues, study skills, or challenges outside of the classroom.

## Conclusions and Further Questions

Scholarship on developmental mathematics has cast doubt on the value of sending large numbers of incoming students into long sequences of prerequisite courses before they are allowed to engage in college-level mathematics. Moving towards corequisite remediation offers the possibility to improve the number of students completing college mathematics courses. However, scholarship on corequisite reforms is in its nascent stages, and it is not clear how the details of reform implementation may impact its success. As the VCCS moves forward with the Direct Enrollment Pilot, educators and administrators will need to address several questions.

- How do colleges involved in the Direct Enrollment Pilot implement reforms, and how do these implementation details affect student success?
- What unanticipated challenges do pilot colleges encounter, and how should they be addressed?
- What modifications to placement and curriculum are needed before such reforms may be expanded across the VCCS?
- What practices to staffing, scheduling, course structure, and instruction ensure student success?
- How can the VCCS monitor the success of reforms beyond measures of pass rates and student retention?

The VCCS Direct Enrollment reforms offer an excellent opportunity to rethink how to prepare students to engage with college level coursework. The engagement and collaboration of faculty and administration across colleges is crucial for the success of these reforms. The next two years will provide many possible lessons, and it is faculty, staff, administrators, and students who will help inform successful implementation and identify educational best practices.

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